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The Energy-Water Nexus: Trends, Challenges and Opportunities

(The Water Utility Perspective)

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Presented by:

Chris Rayburn
Director, Research Management
Awwa Research Foundation

Presentation overview

- What factors and variables will affect energy consumption by water utilities, and how are they trending?
- What challenges and opportunities do these trends present?

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First, two definitions...

- **Alternative water sources**

  Unconventional sources of fresh water supply: wastewater reuse, seawater, brackish groundwater, produced water, etc.

- **Advanced treatment**

  Water treatment technologies beyond conventional coagulation, filtration and chlorine-based disinfection: RO/NF, UV, ozone, etc.

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…and two premises

- Utilization of alternative water sources is increasing and will continue to increase
- Tapping alternative water sources requires advanced treatment

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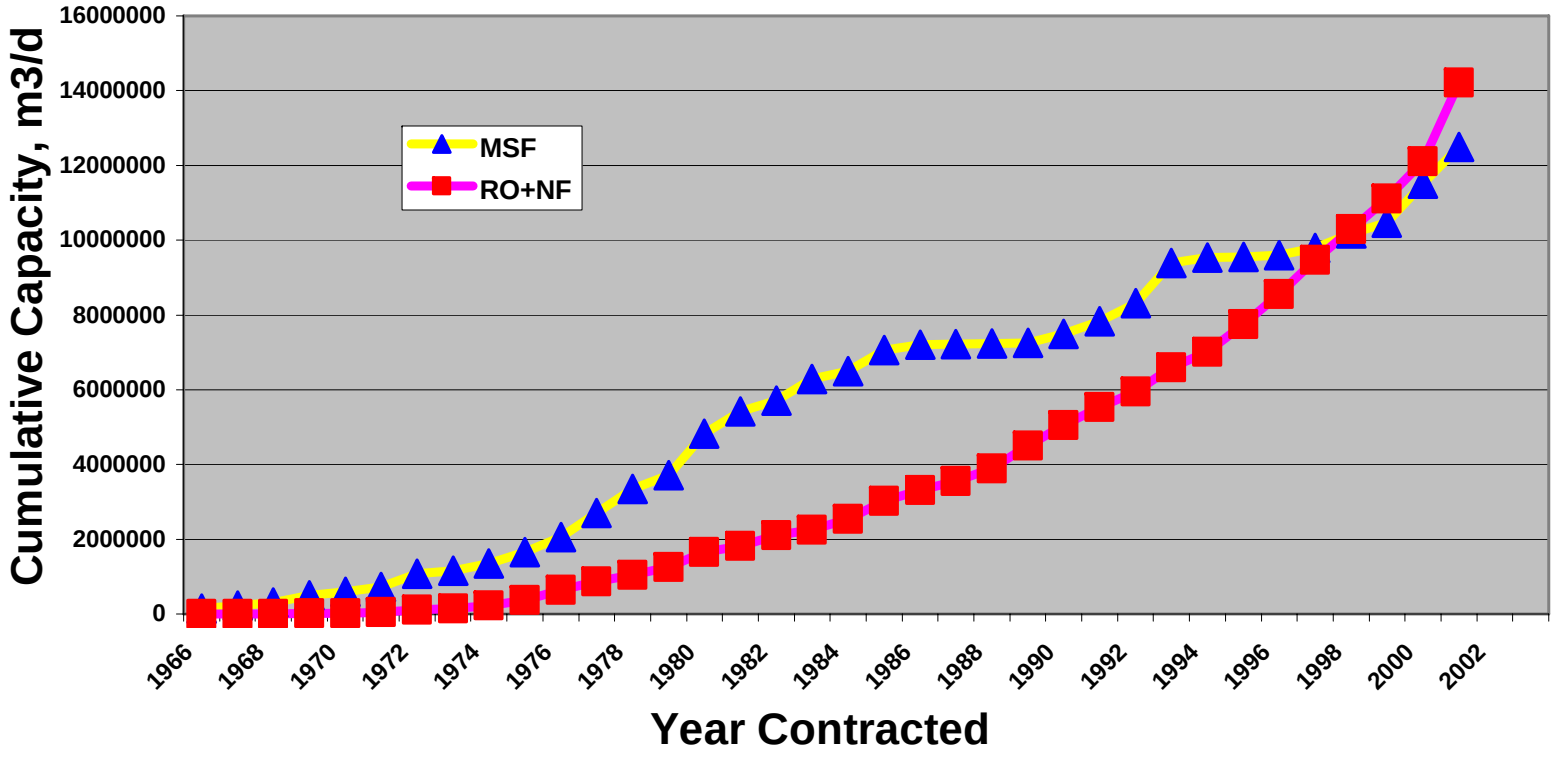
Membrane and Thermal Process Growth



AwwaRF Project 3056, *Evaluation of Dynamic Energy Consumption of Advanced Water and Wastewater Treatment Technologies*

How does the use of advanced treatment affect energy consumption?

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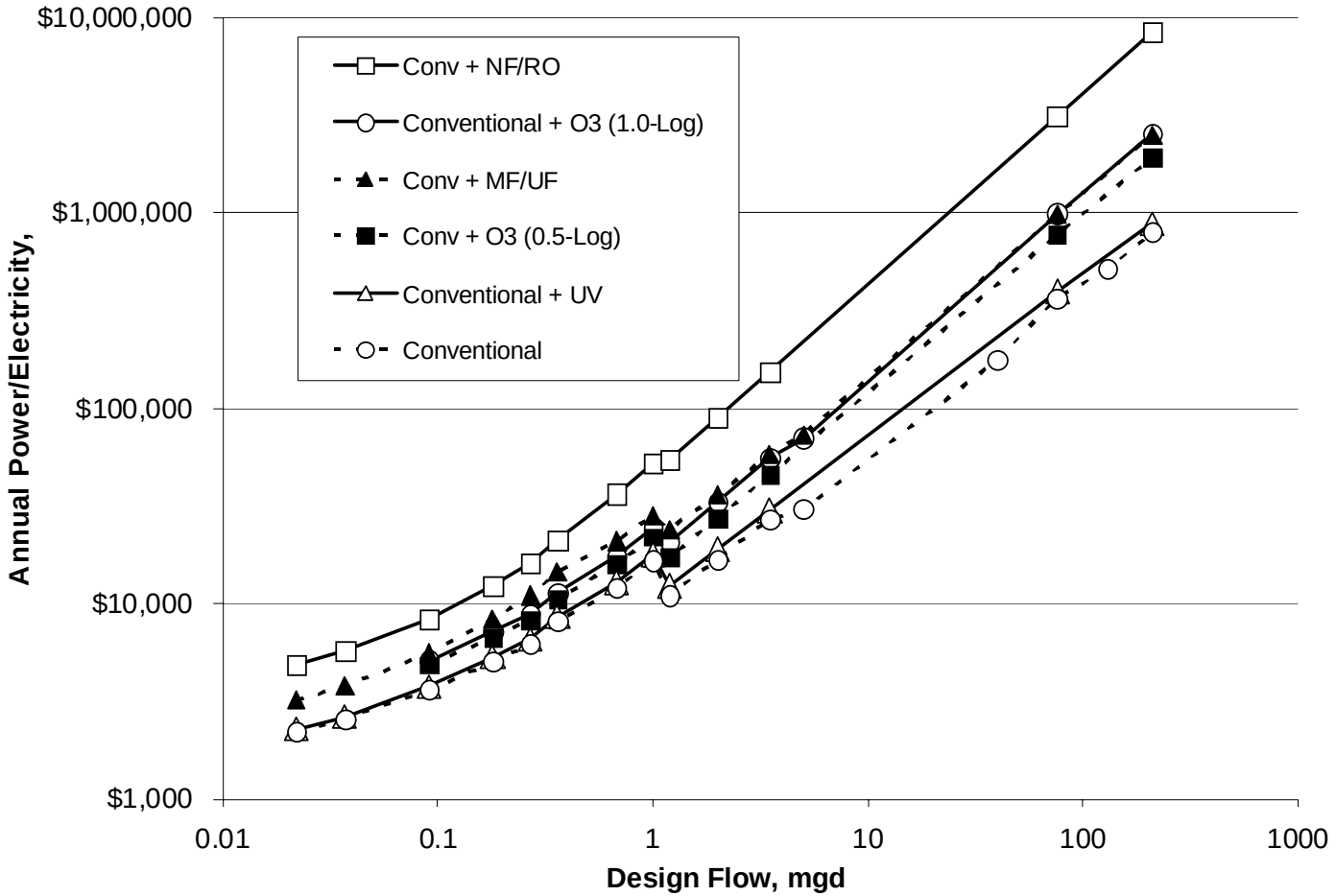

Comparison of annual energy costs for several water treatment technologies

AwwaRF Project 3058, *Assessing Risks and Benefits of Drinking Water Utility Energy Management Practices*

Energy consumption will increase with increasing use of advanced treatment for alternative water sources

BUT

There are many factors and variables that can moderate this increase

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A deceptively simple equation

$$C = V * E$$

C - total energy consumption related to advanced treatment

V - volume produced from alternative water supplies

E - energy efficiency (or energy consumption per unit volume)

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C = V * E

Factors and variables affecting V
(volume produced from alternative water supplies)

"Supply side"

- Volume available from traditional sources

"Demand side"

- Population
- Water cost
- Regulations
- Innovation in water use efficiency
- Culture

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Factors and variables affecting V (cont)

Volume available from traditional sources

(trend: decreasing)

- **Surface water over-allocation**
- **Groundwater overdraft**
- **Climate change forecasts**

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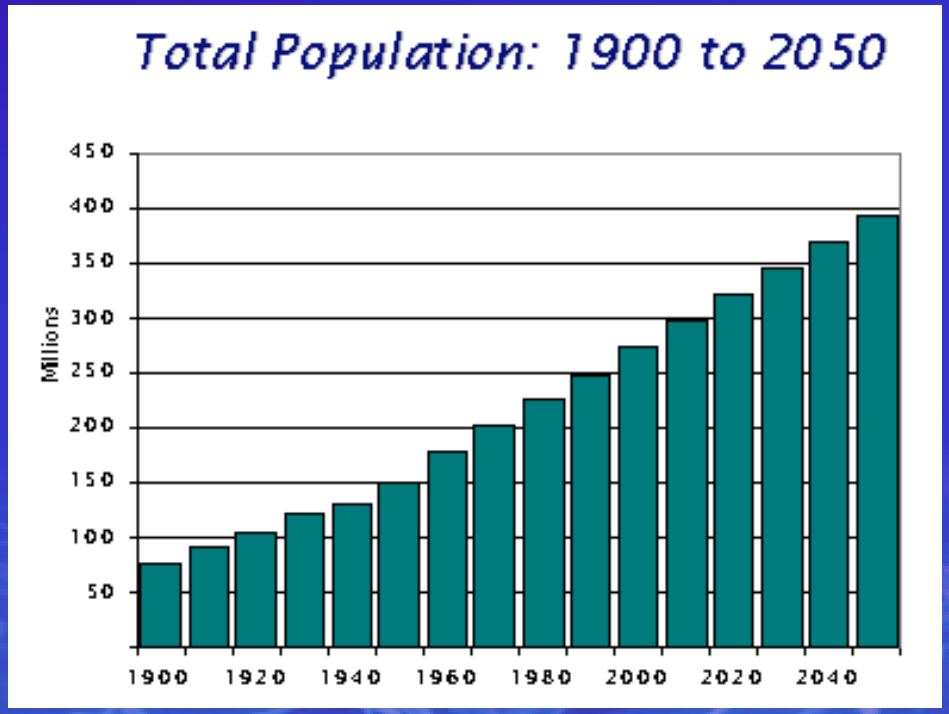
Factors and variables affecting V (cont)

Population

(trend: increasing)



Source: US Census Bureau, Population Division

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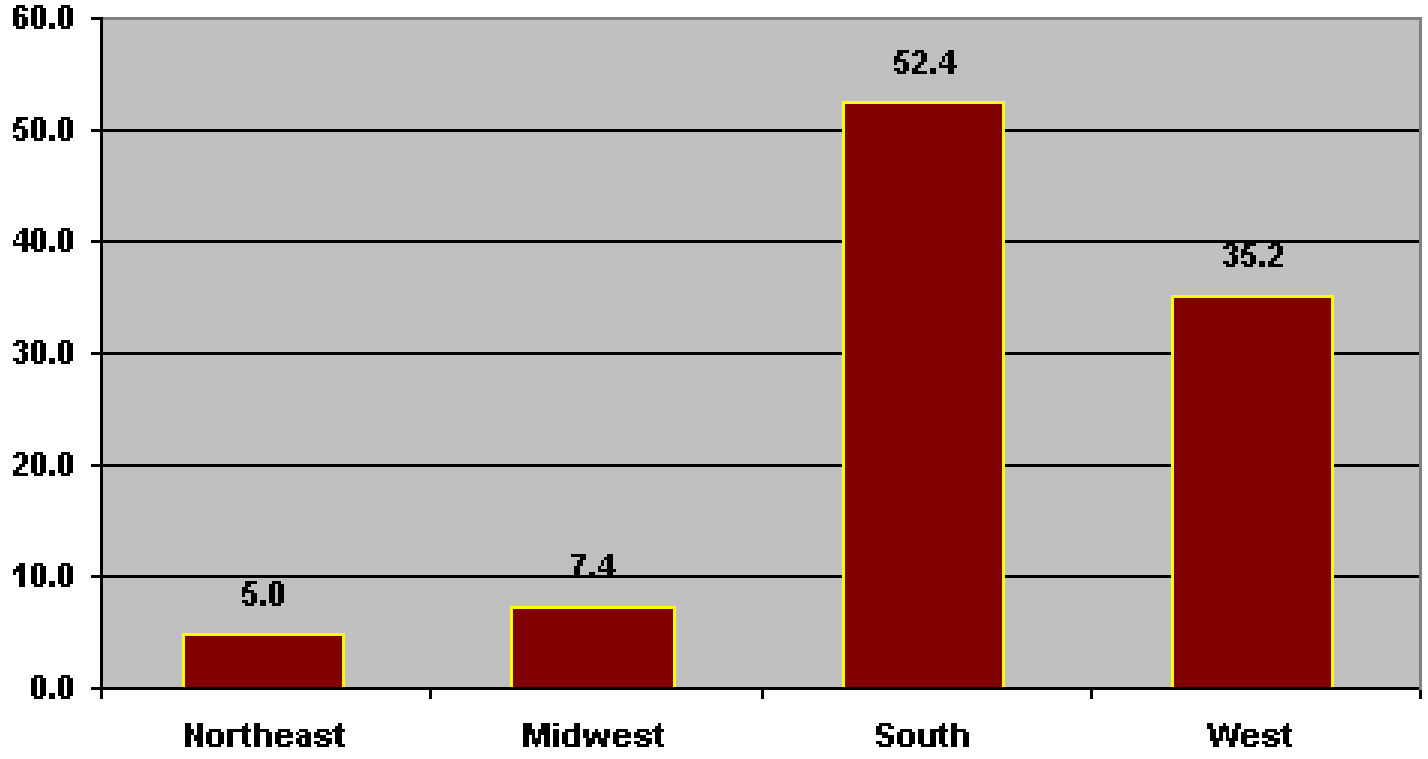
Figure 3: Interim Projections: Percent Distribution of Population Growth by Region of the United States, 2000 to 2030



Source: U.S. Census Bureau, Population Division, Interim State Population Projections, 2005

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Factors and variables affecting V (cont)

Water cost

(trend: increasing)

- Imbalance between water cost and value will increase
- Energy cost is just one driver (infrastructure R&R, etc.)
- Demand management pricing will increase

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"The U.S. average cost of $2 per 1,000 gallons…equates to about five gallons for every penny."

AwwaRF project 2604, *A Strategic Assessment of the Future of Water Utilities*

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Factors and variables affecting V (cont)

Regulations
(trend: increasing)

- Limit alternative source withdrawals
- Limit concentrate disposal options
- Limit carbon emissions/footprint
- Watering restrictions and similar consumption limits

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Factors and variables affecting V (cont)

Innovation in water use efficiency *(trend: increasing)*

- Low flow technologies
- Commercial, agricultural and industrial process improvements
- Water loss prevention
- Xeriscaping

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Factors and variables affecting V (cont)

Culture

(trend: greening)

- Environmental awareness and activism; thinking “green”
- Water education and outreach
- Voluntary conservation

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C = V * E

Factors and variables affecting E
(energy efficiency)

- Innovation in energy use efficiency
- Regional water transfers

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Factors and variables affecting E (cont)

Innovation in energy use efficiency *(trend: increasing)*

- Membrane materials, design, fouling control
- New water purification technologies
- Energy recovery
- “Purple pipe” irrigation (reduced level of treatment = reduced energy consumption)

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Factors and variables affecting E (cont)

Regional water transfers

(trend: decreasing...?)

- Tapping alternative supply can reduce need for water importation
- Associated energy savings can help offset advanced treatment energy consumption

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C = V * E

Factors and variables affecting C--?
(total energy consumption)

- Many water utilities perceive energy supply as essentially limitless; if more is needed, it will be there
- (These water utilities are not in California)

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C = V * E

Summary

- Increasing population and decreasing traditional water supply will likely increase energy demand by western water utilities over the coming 10-20 years
- There are a number of variables that can act to moderate this increase
- These variables make the magnitude of the increase very difficult to quantify

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What challenges and opportunities do these trends present?

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Challenges…

- Many variables make the future tough to forecast
- Social, environmental and economic sustainability are at stake
- Will require change and political will

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…and Opportunities!

- Many variables mean there are many areas for potential improvements
- Increased public education and awareness about water
- Drivers to recognize and change unsustainable practices
- Drivers for innovation

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Where should the drinking water community focus its efforts?

- Portfolio approach—diversify supply
  - Alternative sources are part of the solution, not THE solution
- Raise customer awareness about water challenges and opportunities
- Price water to reflect true value
- Support innovation and technology improvements

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Thank You!
Chris Rayburn
Director, Research Management
Awwa Research Foundation
(303) 347-6188
crayburn@awwarf.org